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EDITORIALS

Air pollution and cognition

Another reason to cut air pollution and record the health benefits likely to follow

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It is almost 20 years since leaded petrol was banned in the UK to protect children's brains from its damaging effects—a move forced on the delaying UK government by a European directive from Brussels. Other components of traffic related air pollution, including carbon monoxide and polycyclic aromatic hydrocarbons, have also been shown to be neurotoxic,[1 2] and increasing numbers of studies support the view that poor air quality can have adverse effects on the brain, from suboptimal cognitive development in children[3] to accelerated cognitive decline in adults.[4 5]

In Barcelona, children attending primary schools in high pollution areas had slower rates of cognitive development compared with those attending schools in low pollution areas.[3] In adults in China, long term exposure to air pollution has been linked to worse cognitive performance in verbal and maths tests.[6]

As with all new scientific observations, uncertainties remain (specifically, on the underlying causal mechanisms and critical exposure windows), as well as challenging inconsistencies. We have better evidence on cognitive development in children than on cognitive decline among older people, for example,[7] although the evidence linking incident dementia with long term exposure to air pollution seems increasingly robust, as study findings are replicated.[8]

A recent cohort analysis of 140 000 people registered with 75 London general practices, found a significant association between exposure to higher pollution levels and a diagnosis of dementia.[4] Adults living in the highest quintile of nitrogen dioxide (NO_2) exposure had a 40% higher risk of dementia than those in the lowest quintile. In the highest quintile, exposure equated to an annual mean concentration of >41 $\mu g/m^3$ NO_2, a level commonly found in London and many other UK towns and cities, largely because of a high density of diesel vehicles.

Causal pathways

Mechanistically, there are substantial gaps in our knowledge, though established associations between ischaemic stroke and short term exposure to gaseous and particulate air pollution[9] provide a possible causal pathway for vascular dementia. Tantalisingly, combustion derived particulates have been found in postmortem brain samples,[10] and early molecular and histopathological features of Alzheimer's disease have been identified in children and young adults living in polluted cities in Mexico.[11 12]

Particulate matter (soot, largely from diesel engines) has also recently been observed in macrophages in the placentas of women living in London,[13] suggesting a mechanism for a link with low birth weight[14] and reduced head circumference at birth.[15]

Evidence of adverse effects of traffic related air pollution over the life course continues to grow, as succinctly summarised in the report by the Royal College of Physicians' working party in 2016.[16] The report recommended urgent action to reduce air pollution and improve health. Persuasive recent data on cognition and cognitive development add impetus to that recommendation.

Evidence to support pollution measures

Government and local authorities need to take bold action to reduce traffic related air pollution, especially in highly populated urban areas, and researchers should exploit such policy initiatives when they arise, to evaluate the effectiveness of these actions. Researchers leading the influential California Children's Health Study, for example, showed that poor air quality was associated with slower growth in lung function in adolescents,[17] and went on to show that, as air quality improved after public health measures, lung growth also improved. Their approach[18] strengthened the evidence for both the adverse effects of air pollution and the benefits of intervention.

As the first World Health Organization conference on air pollution and health ends in Geneva, and the UK Health Alliance on Climate Change publishes a new report calling for more urgent action,[19] it's time to cut pollution and measure the effects. The introduction of London's ultra low emission zone next year is one example of a bold intervention that gives researchers the opportunity to evaluate the link between air quality and health throughout life—from birth weight, through cognitive development in children and incidence of non-communicable

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diseases such as heart attacks and stroke, to dementia and both disease-specific and all-cause mortality.

The introduction of such schemes is politically challenging. Evidence that they deliver measurable health dividends will improve public confidence and generate support. Here the scientific and medical communities need to tread carefully, staying at arm's length from the politicians but delivering clear objective assessments to guide the development of evidence based public health policies.

At a time when science is often denigrated at home and overseas, the application of the scientific method has never been more important.

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